SEE Test Report V2.0
Proton test of HCPL625K from Agilent Technologies

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I. Introduction

This study was undertaken to determine the single event transient susceptibility of the HCPL625K 4 channels logic gate optocoupler. The device was monitored for transient interruptions in the output signal by exposing it to a proton beam at the Indiana University Cyclotron Facility (IUCF), Bloomington, IN. This test was performed in the frame of AQUARIUS project.

II. Devices Tested

The sample size of the testing is 4 devices. The device is manufactured by Agilent Technologies. The test samples have a Lot Date Code of 0534.

Each channel contains an AlGaAs light emitting diode (LED) coupled to an integrated high gain photon detector. The device is packaged in a 16 lead ceramic Flat Pack.

III. Test Facility

Facility: IUCF

Energy: 200 and 89 MeV
Flux: 1 x 10^7 to 1 x 10^8 particles/cm^2/s
Fluence: All tests were run to 1 x 10^{10} p/cm^2 or until at least 200 transient events occurred.

IV. Test Conditions and Error Modes

Test Temperature: Room Temperature
Power Supply Voltage: + 5V
Input current: 5mA
PARAMETERS OF INTEREST: Output voltage

SEE Conditions: A SET in this device is defined as a perturbation of the output signal (voltage dropout) of more than 2.5V.

V. Test Methods

Test circuit for the optocoupler device under test (DUT) contains a power supply, an input current source, and a digital scope for capturing any output anomalies. Once the DUT power supply and the input current are present, the digital scope is set to trigger on output voltages that are below a predetermined threshold (set to 1V).

DUT bias conditions are shown in Figure 1. The four device's outputs were monitored. DUT was tested both in on and off states (high and low output levels respectively).

Opto_Coupler Schematic Diagram

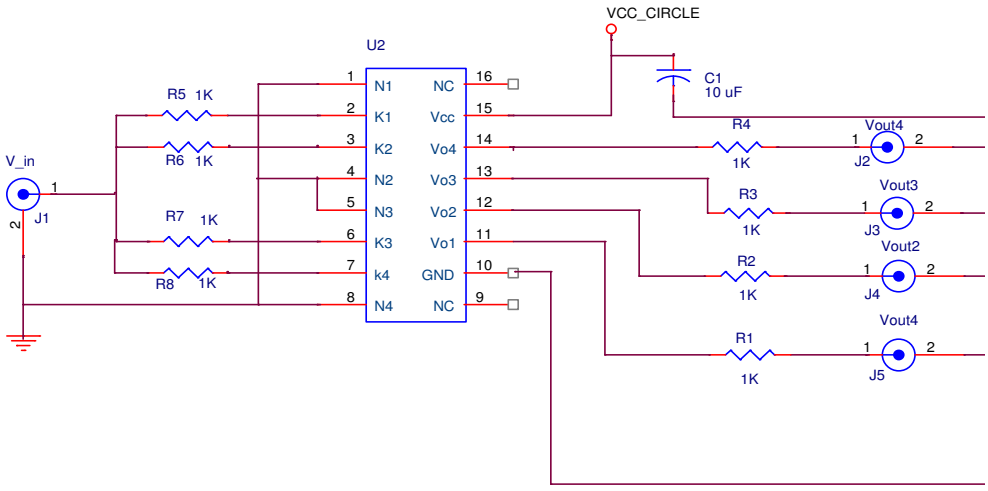

Figure 1: HCPL625K bias conditions

VI. Test Results

Test results are presented in Table 1. HCPL625K is sensitive to SET both in the on and off states. SET cross section curves for normal incidence are shown in Figure 2. We can see that the optocoupler is about 10 times more sensitive in the off state. Figure 3 shows the SET cross-sections curves on SN2 for the different angles of incidence. We cannot see an effect of the angle of incidence on SET cross-section. However, grazing incidence tests were only performed at the highest energy of 200 MeV. Lower energy protons, having an higher LET, may cause increased sensitivity at grazing angles.

Table 1: HCPL625K, test results

Run #	SN #	state	Energy (MeV)	tilt (°)	flux (#/cm^2-s)	fluence (#/cm^2)	dose (krad-Si)	inc dose (krad-Si)	SET #	Xsect (cm^2/chan)	Comment
1	1	on (high)	200	0	9.40E+07	1.00E+10	0.6	0.6	94	2.35E-09	Vout~3.5V, threshold~Vout-500mV, 4 channels
2	1	on (high)	200	0	1.20E+08	1.00E+10	0.6	1.2	123	3.08E-09	1V threshold
3	1	off(low)	200	0	1.20E+08	4.94E+09	0.3	1.5	810	4.10E-08	
4	1	off(low)	200	0	1.95E+07	1.54E+09	0.1	1.6	305	4.95E-08	
5	2	off(low)	200	0	2.00E+07	1.72E+09	0.1	0.1	300	4.36E-08	
6	2	on (high)	200	0	1.75E+07	1.00E+10	0.6	0.7	77	1.93E-09	
7	3	on (high)	200	0	2.13E+07	1.00E+10	0.6	0.6	96	2.40E-09	
8	3	off(low)	200	0	2.14E+07	1.59E+09	0.1	0.7	339	5.33E-08	
9	3	off(low)	200	grazing	2.10E+07	1.59E+09	0.1	0.8	406	6.38E-08	tilt around Y
10	3	on (high)	200	grazing	1.94E+07	1.00E+10	0.6	1.4	85	2.13E-09	
11	3	on (high)	200	grazing2	1.81E+07	1.00E+10	0.6	2.0	91	2.28E-09	tilt around Y and X
12	3	off(low)	200	grazing2	1.97E+07	1.71E+09	0.1	2.1	472	6.90E-08	
13	3	off(low)	89	0	3.80E+06	8.02E+08	0.1	2.2	236	7.36E-08	
14	3	on (high)	89	0	2.30E+07	1.00E+10	1.0	3.2	87	2.18E-09	
15	4	on (high)	89	0	2.50E+07	9.34E+09	1.0	1.0	40	1.07E-09	
16	4	off(low)	89	0	2.50E+07	2.50E+09	0.3	1.2	661	6.61E-08	
17	2	on (high)	89	0	2.60E+07	2.60E+09	0.3	1.0			run cancelled
18	2	on (high)	89	0	2.40E+07	1.00E+10	1.0	2.0	65	1.63E-09	
19	2	off(low)	89	0	2.30E+07	1.90E+09	0.2	2.2	500	6.58E-08	

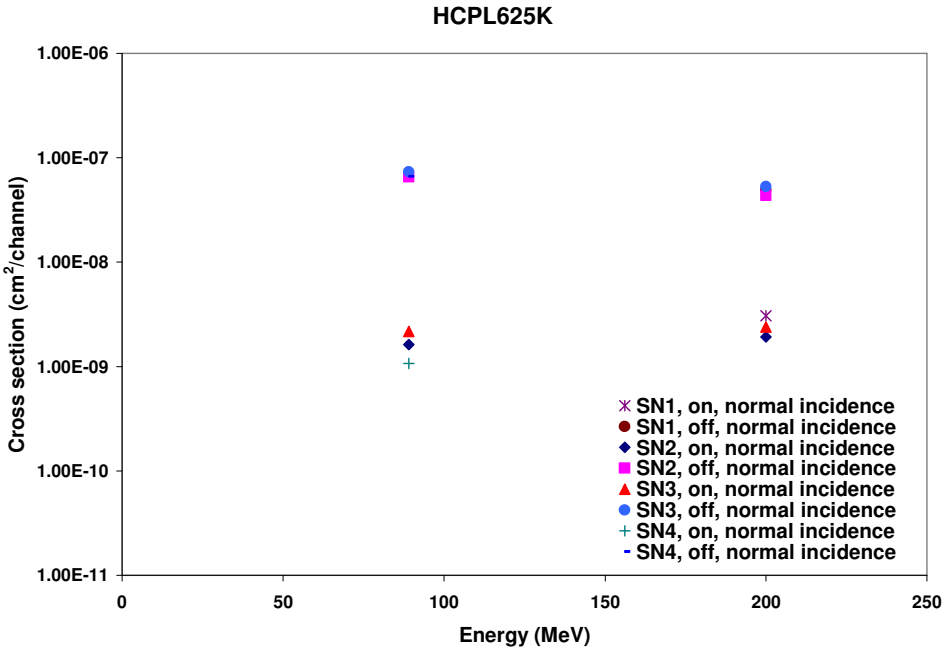

Figure 2: SET cross-section curve at normal incidence

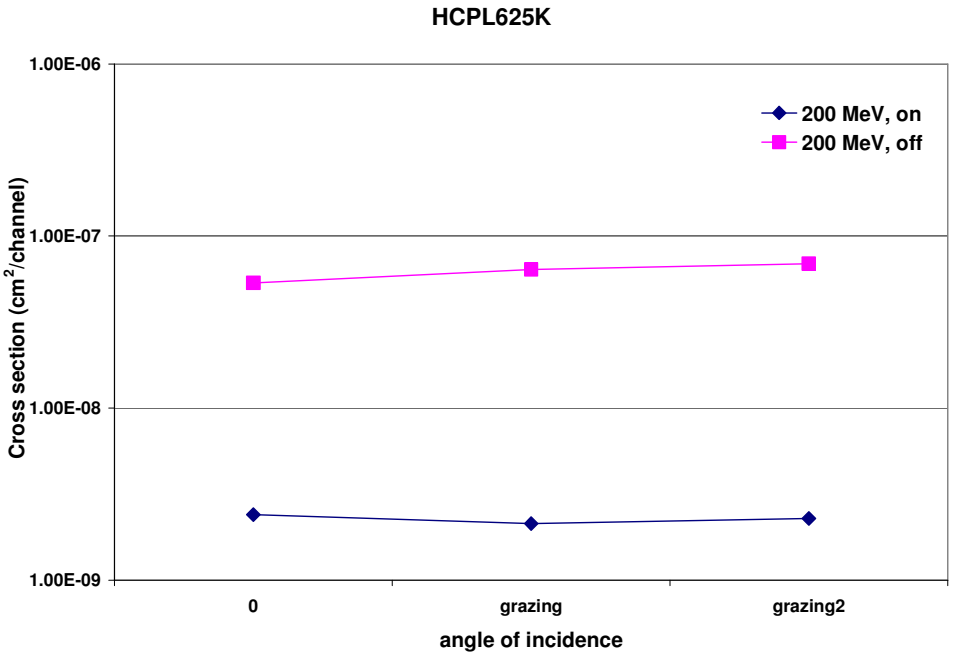

Figure 3: SET cross-section curve on SN2 versus angle of incidence

Typical SET waveforms for the on and off states are shown in Figures 4 and 5 respectively. SET duration is short. Maximum measured SET duration is 150 ns. However, SET amplitude is large. All SET have an amplitude greater than 2.5V; therefore, the optocoupler output logical levels changes during a SET

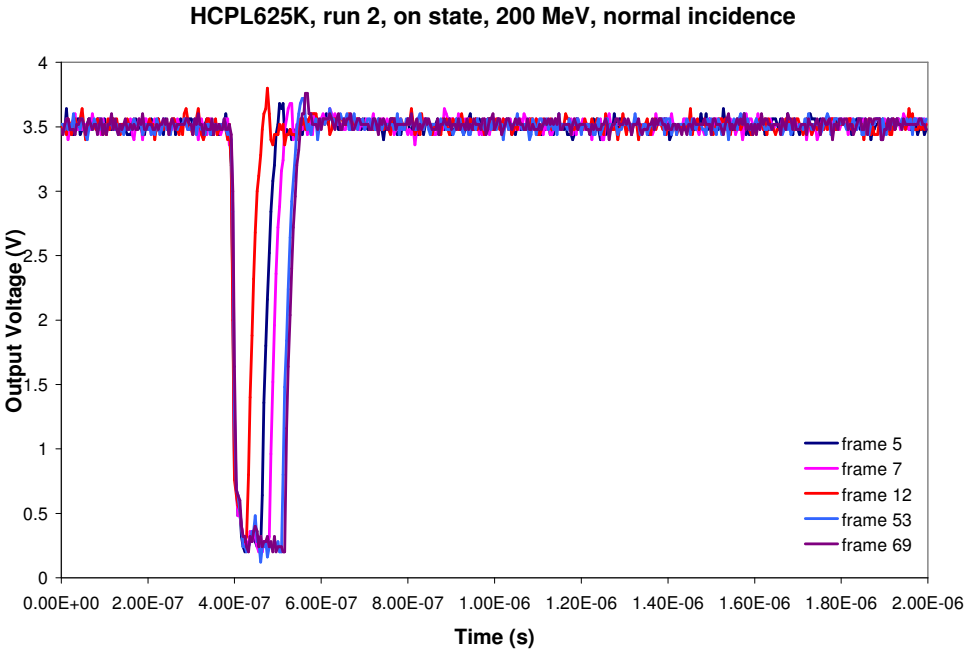

Figure 4: SET waveform, on state

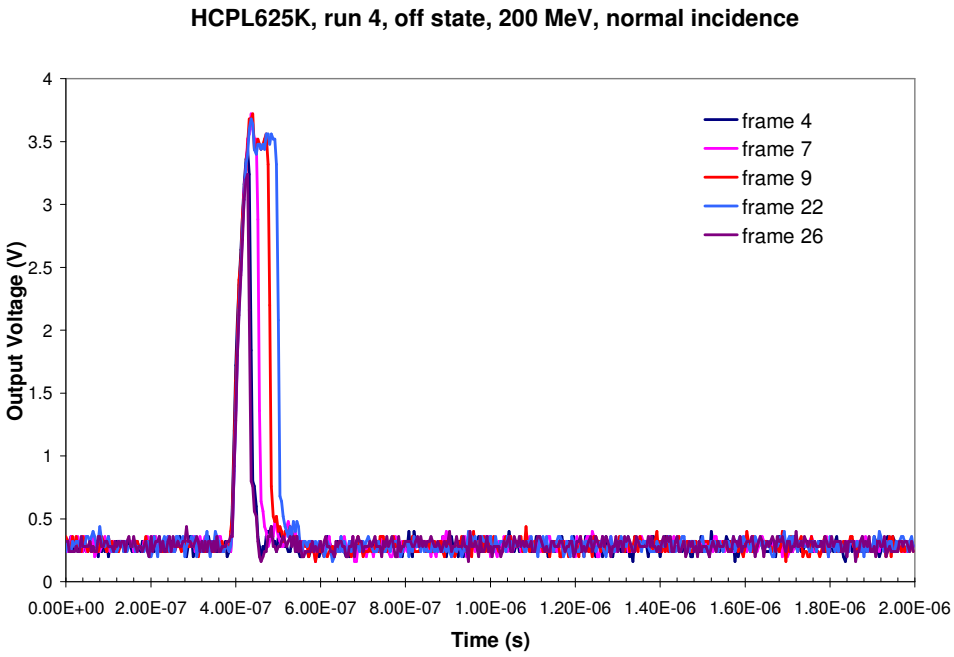

Figure 5: SET waveforms, off state

Appendix 1:

- http://www.avagotech.com/pc/downloadDocument.do?id=3283